All Income Is Not Created Equal: Cross-Tax Elasticity Estimates in the United States

Jacob A. Mortenson*

March 2016

Abstract

In the United States, marginal tax rates on capital income and ordinary income (e.g. wages and salaries) can vary substantially. The same household might face a federal tax rate on their wage income that is 20 percentage points higher than the tax rate on long-term capital gains. This differential complicates welfare and revenue analyses of tax reforms, as individuals might alter their capital income decisions in response to an ordinary income tax change. In this paper, I estimate cross-tax elasticities for capital and ordinary income, using a large non-public panel of federal income tax returns from 1997-2007. I find two key results, though both are sensitive to a variety of specification decisions. First, capital gains respond to both the capital gains tax rate and the ordinary income tax rate. Second, I find mixed evidence that ordinary income responds to the ordinary income tax rate and the long-term capital gains tax rate. These results suggest cross-tax responses between these two bases are important, and should not be ignored when estimating taxpayer responses in the United States.

Keywords: Elasticity of Taxable Income, Cross-Tax Elasticity, Income Taxation, Behavioral Response, Public Finance.

JEL Code: H24

*Georgetown University and the Joint Committee on Taxation. Intercultural Center 580, 37th and O Streets, N.W., Washington D.C. 20057-1036 (e-mail: jm849@georgetown.edu). This research embodies work undertaken by a staff member of the Joint Committee on Taxation, but as members of both parties and both houses of Congress comprise the Joint Committee on Taxation, this work should not be construed to represent the position of any member of the Committee. I would like to thank Bradley Heim, Tim Dowd, Robert McClelland, and Caroline Weber for providing me with code. I would also like to thank Jon Bakija for the use of his marginal tax rate calculator. Financial support from the Economic Club of Washington, D.C., the Consortium of Universities of the Washington Metropolitan Area, and the Georgetown Graduate School of Arts and Sciences is gratefully acknowledged. Comments and advice from Claire Brunel, Tim Dowd, Paul Landefeld, Arik Levinson, Caroline Weber, Andrew Whitten, and numerous conference and seminar participants are also gratefully acknowledged. All errors are my own.

1 Introduction

Many households in the United States face an effective marginal tax rate on long-term capital gains that is over 20 percentage points lower than the effective marginal tax rate applicable to their next dollar of wage income. Differential tax rates alter the relative after-tax return between different income earning activities, and likely induce individuals to change their patterns of saving, investment, or labor supply. In this paper, I estimate the extent to which individuals respond to this differential.

The deadweight loss or social cost associated with income taxation is generally an increasing function of taxpayer responsiveness. Estimates of the size and magnitude of taxpayer responses are necessary for estimating these costs and any tax revenue consequences of income tax changes. Understanding the nature of the response is important as well. Working fewer hours in response to a tax increase has different welfare and revenue implications than deciding to report less income. Similarly, shifting income earning activities between income types has different consequences than adjusting only one type. If income flows from one type of income to another in response to a tax increase the social cost of taxation is mitigated (Piketty, Saez, and Stantcheva, 2014).

Tax rate differentials might drive income responses in several ways. Fundamentally, decisions to work and save are generally not made in isolation. Both of these decisions depend on the after-tax return to working and saving, which are themselves functions of the tax rates on both activities. For example, a reduction in long-term capital gains rates might increase the present discounted value of a retiree's savings, causing them to retire early. Portfolio composition is also affected by tax differentials, as savings could generate ordinary income (e.g. interest from savings accounts) or long-term capital gains (e.g. returns realized from stock sales). Additionally, investment financing by firms or individuals is likely a function of tax differentials.

Surprisingly, microeconomic evidence of individual income responses to tax rate changes across income types in the United States is limited. Most work estimates the responsiveness of ordinary income to ordinary income tax rates, or capital gains to capital gains tax rates. Many consider inter-temporal responses within an income type, but few consider cross-income responses to changes in tax rates.

I analyze these issues using a large panel of non-public U.S. federal income tax returns spanning 1997 to 2007. This time period includes two major federal tax reforms the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) and the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) as well as several smaller federal and state level reforms. These reforms generate cross-sectional and time-series variation in marginal tax rates used to identify elasticity estimates.

I focus on the degree to which ordinary income and long-term capital gains income are substitutable in the United States. I choose these types because the difference between long-term capital gains tax rates and ordinary income tax rates are large and salient, but in principle cross-tax effects could exist between any two tax bases with different tax rates. Responses to tax rates applied to different types of income are referred to as "cross-tax" responses, and are analogous to"cross-price" elasticities in a demand system. Responses of a given income type to changes in its own tax rate are referred to as "own-tax" responses.

I estimate cross-tax responses separately for both types of income: the effect of long-term capital gains taxes on ordinary income, and the effect of ordinary income tax rates on long-term capital gains realizations.[1] I find significant ordinary income cross-tax effects on capital gains, and find slightly weaker evidence of ordinary income responses to changes in capital gains tax rates.[2] Both sets of results are sensitive to specification decisions. In particular, statistically significant cross-tax effects in the capital gains setting vary depending on whether I consider one year or multi-year responses to tax rates. In the ordinary income setting, choice of year differences affect results.

The own-tax elasticity estimates for each income type are also interesting. Notably, estimates of ordinary income responses to ordinary income tax rate changes elicited by the Bush Tax Cuts are not discernible from zero in the standard framework abstracting away from cross-tax effects effects. This is inconsistent with other papers estimating elasticities using EGTRRA and JGTRRA. These papers suggest a 10% increase in the net-of-tax rate on ordinary income is associated with a 3 or 4% increase in ordinary income (Auten, Carroll, and Gee (2008); Heim (2009); Singleton (2011)). Similarly, after implementing a series of econometric improvements following Weber (2014b) and Weber (2014a) I still fail to reject that ordinary income did not respond to changes in ordinary income tax rates associated with EGTRRA or JGTRRA. Including the net-of-tax rate on long-term capital gains produces some evidence suggestive of own-tax ordinary income responses, though the results are sensitive to such an extent that I do not have a preferred estimate.

My preferred estimate of persistent long-term capital gains realizations responses to cap-

[1]While I include "ordinary" dividends in my definition of ordinary income, capital gains realizations do not include "qualified" dividends created as part of JGTRRA. See Chetty and Saez (2005) or Kawano (2014) for firm and individual responses to the dividend tax cut.

[2]Kleven and Schultz (2014) estimate cross-tax elasticities in Denmark, and find the effect of labor income taxes has an effect on gross capital income. They also find labor income is not responsive to capital income taxes.

ital gains taxes is similar to existing estimates in this time period, and is statistically significantly different from zero: -0.90.[3] However, the transitory elasticity – arguably much less important than the persistent elasticity – is indistinguishable from zero. My transitory elasticity estimate differs from Dowd, McClelland, and Muthitacharoen (2015), and likely stems from my using one year less data.

The results of this paper suggest cross-tax responses between long-term capital gains and ordinary income bases should be taken into account when evaluating proposed changes to marginal income tax rates. Further, they suggest conventional welfare and revenue analyses, which assume zero cross-tax elasticities, may be misleading. Given the wide range of point estimates – including some that are statistically indistinguishable from zero – I do not have a preferred point estimate, but the consistency of the direction of the effect (suggesting the two income types are substitutes) is strong and robust to specification decisions.

2 Review of Existing Work Estimating Taxable Income Elasticities

Most research on the elasticity of taxable income uses tax reforms as quasi-natural experiments to estimate how individuals' taxable income responds to changes in their marginal tax rates. Marginal tax rate changes at the state and federal levels vary across tax units depending on their household composition, income level, income composition, and state of residence. This cross sectional variation in the effect of tax reforms allows for identification of a continuous treatment equation. Researchers mostly use samples of individual income tax returns to measure taxable income and an individual and state-of-residence specific marginal tax rate calculator to estimate a household's state and federal marginal tax rates.[4] The endogeneity that arises naturally through the mechanical relationship between income and marginal income tax rates is addressed using instrumental variables, which vary depending on the type of income in question.[5]

Two separate bodies of work estimate taxable income elasticities in the United States.

[3] Dowd, McClelland, and Muthitacharoen (2015) find a persistent long-term capital gains elasticity of -0.79, which suggests a 10% increase in capital gains taxes is associated with a reduction in capital gains realizations of roughly 8%.

[4] See Burns and Ziliak (2015) for estimates of ordinary income own-tax elasticities using the Current Population Survey.

[5] A more recent body or work estimates tax elasticities by examining the degree to which taxpayers bunch at kink points. See Saez (2010) or Mortenson and Whitten (2016) for a U.S. study, Bastani and Selin (2014) for Sweden, Chetty, Friedman, Olsen, and Pistaferri (2011) or Le Maire and Schjerning (2013) for Denmark, or Kleven and Waseem (2013) for Pakistan.

One estimates the responsiveness of ordinary income, which is essentially total or taxable income less capital gains, and the other focuses on long-term capital gains realizations, which are the realized nominal appreciation from the sale of an asset held at least one year. These two literatures largely fail to interact with one another. The ordinary income literature assumes short and long-term capital gains do not exist. The long-term capital gains literature assumes (a modified form of) ordinary income is exogenous. Both implicitly assume responses to tax rates on other types of income are zero. I review these two literatures briefly.

2.1 Ordinary Income

An extensive and active body of work estimates own-tax ordinary income elasticities in the general style described in the preceding two paragraphs (Feldstein (1995); Auten and Carroll (1999); Gruber and Saez (2002); Kopczuk (2005); Giertz (2007); Auten, Carroll, and Gee (2008); Heim (2009); Giertz (2010); Singleton (2011); Chetty (2012); Weber (2014a); Weber (2014b)). Saez, Slemrod, and Giertz (2012) review the literature, and conclude the best estimates of a "long-run" elasticity of taxable ordinary income range from 0.12 to 0.40 in the United States. An elasticity at the top of this range, 0.40, suggests that taxable ordinary income will increase by 4 percent in response to a 10 percent decrease in the *net-of-tax* rate $(1-\tau)$.

My paper is not the first to use the"Bush Tax Cuts" (i.e. EGTRRA and JGTRRA) as identifying variation: Auten, Carroll, and Gee (2008), Heim (2009), and Singleton (2011) use them to estimate ordinary own-tax elasticities. Their estimates range from 0.2 to 0.7, with most estimates around 0.4.[6] Each paper uses different panels containing individual earnings and examines slightly different combinations of years, and Singleton employs a different empirical specification than most previous studies.

However, recent work by Caroline Weber argues that most ordinary income tax elasticity papers use endogenous instruments. Weber estimates taxable ordinary income own-tax elasticities surrounding the Tax Reform Act of 1986. Replicating the seminal work in this literature, Gruber and Saez (2002), Weber finds that elasticity estimates increase from 0.3 to 0.9 when using the approximately exogenous instruments. Auten and Kawano (2011) apply Weber's instruments to the Tax Reform Act of 1993. My paper represents the first application of these instruments to the Bush Tax Cuts.

[6] See Heim and Mortenson (2016) for a corrected version of Heim's results, wherein the elasticity estimates are indistinguishable from zero.

2.2 Long-term Capital Gains Income

A much smaller body of work in the past twenty years estimates own-tax elasticities of realized long-term capital gains (Burman and Randolph (1994); Auerbach and Siegel (2000); Dowd et al. (2015)). The empirical specification in this literature - developed by Burman and Randolph (1994) - is a Tobit style sample selection model and reflects two key differences from ordinary income. First, capital gains realizations are further removed from a Haig-Simons definition of income than most elements of ordinary income. In particular, accruals in capital assets are treated as income under Haig-Simons, while realizations of nominal gains (generated from the sale of a capital asset held more than one year) are taxable income in the United States. Second, most households do have net positive long-term capital gains realizations in the United States in a given year.

Dowd et al. is the only study to estimate capital gains tax elasticities using the 2001 and 2003 reforms. Their preferred long-run estimate is -0.79, larger (in absolute terms) than that estimated by Burman and Randolph using the 1981 tax reform (-0.19), but smaller than that of Auerbach and Siegel using the 1986 and 1993 tax reforms (-1.72).[7] Transitory elasticity estimates are much larger, and vary to an even greater degree (ranging from -1.2 to -6.4). Taken together, however, it seems capital gains realizations are much more responsive to changes in its own tax rate than ordinary income realizations. This conforms with theoretical predictions, to the extent capital is more mobile than labor income (the largest component of ordinary income) and because capital gains *realizations* are taxed, as opposed to accrued capital gains. Realizations can be timed with taxes and asset price fluctuations in mind.

2.3 Cross-Tax Elasticities

Two papers estimate cross-tax elasticities between capital income and labor income, but both do so with significant qualifications. Kleven and Schultz (2014) utilize administrative and tax information on the population of Denmark between 1980 and 2005 to estimate own-tax and cross-tax elasticities of labor income and capital income. They estimate cross-tax elasticities between these types of income, but only for individuals with *negative* capital income. They find that cross-tax elasticities between these two income types are small and negative. This suggests that capital and labor income are substitutes in the Danish tax system for this

[7] The expected sign on the elasticity in the capital gains setting is negative because the elasticity is calculated with respect to the tax rate, τ, as opposed to the net-of-tax rate used in the ordinary income setting, $1 - \tau$.

sub-population, and that at least some taxpayers respond to changes in marginal tax rates across income types.

Auten and Kawano (2011) investigate an array of taxable income responses to the Omnibus Budget Reconciliation Act of 1993 (OBRA). OBRA increased ordinary income marginal tax rates, but did not change long-term capital gains rates. Auten and Kawano have one specification in which long-term capital gains realizations are the dependent variable and ordinary income tax rates are included as an independent variable (instrumental variables following Weber (2014b) are used). They find that long-term capital gains increase in response to the increase in ordinary income tax rates, but note that they do not address the sample selection issues associated with estimating capital gains tax elasticities.[8]

Cross-tax responses create "fiscal externalities." Saez, Slemrod, and Giertz (2012) define a fiscal externality as "a change in the present value of tax revenue that occurs in any tax base z' other than z due to the behavioral response of private agents to the tax change in the initial base z" (p. 10). A tax base is defined as taxable income of a given type in a given time period. When tax bases have different tax rates, individuals have an incentive to shift income – whether through accounting tricks or re-allocation of resources – to lower taxed bases.[9]

Given preferential (lower) long-term capital gains tax rates, this incentive exists between ordinary income and long-term capital gains in the United States. Saez et al. agree, arguing that the differential between long-term capital gains and ordinary income "matters and should ideally be controlled for in analyses of how the tax rate on ordinary income affects the reported amount of ordinary income" (p. 32). This paper takes some of the first steps toward achieving that ideal.

3 Theoretical Motivation

The reduced form estimation equation for taxable income elasticities falls out of a standard, static theoretic framework for income earning behavior. Following Kleven and Schultz (2014), individuals maximize utility by making consumption (c) and income earning ($\mathbf{z}$) decisions with a composite consumption good and n income types, given individual characteristics ($\mathbf{x}$)

[8] "Sample selection" issues refer to the large amount of zeros in the dependent variable. That is, most tax units do not realize long-term capital gains in a given year. However, presumably many of these tax units also do not have unrealized long-term capital gains.

[9] Fiscal externalities have been investigated in other contexts, most notably the shift from corporate income to pass-through entity income in response to the Tax Reform Act of 1986.

and a tax regime:

$$\max_{c,\mathbf{z}} \quad u(c, \mathbf{z}, \mathbf{x}) \tag{1}$$

$$c = \sum_{j=1}^{n} z^j - T(\mathbf{z}) = \sum_{j=1}^{n} (1 - \tau^j) z^j + y \tag{2}$$

$$y \equiv \sum_{j=1}^{n} \tau^j z^j - T(\mathbf{z})$$

In this framework each individual income choice z^j is the result of some underlying trade-offs, such as a trade-off between supplying labor and consuming leisure or trade-off between earning different types of income. The individual has claim to after-tax income, which is the difference between the sum of each income type z^j and total tax liability ($T(.)$). After-tax income can be rearranged to be a function of virtual income y and the marginal net-of-tax return to each type of income. The optimal choice of $\mathbf{z}$ is a function of the tax rates on all other types of income, and virtual income (y):

$$z^j = z^j(1 - \tau^1, \ldots, 1 - \tau^n, y, \mathbf{x}) \tag{3}$$

Here I extend the derivation in Gruber and Saez (2002), allowing for multiple income types. A total differentiation of (3) produces:

$$dz^j = \frac{\partial z^j}{\partial(1 - \tau^j)} d(1 - \tau^j) + \sum_{k \neq j}^{n} \frac{\partial z^j}{\partial(1 - \tau^k)} d(1 - \tau^k) + \frac{\partial z^j}{\partial y} dy. \tag{4}$$

The uncompensated cross-tax elasticity of income type j, with respect to the tax rate on income type k, takes the form

$$\xi^{jk} \equiv \frac{\partial z^j}{\partial(1 - \tau^k)} \frac{(1 - \tau^k)}{z^j}$$

and the income elasticity is[10]

$$\eta^j \equiv \frac{\partial z^j}{\partial y} \frac{y}{z^j}.$$

[10]This construction of the income elasticity follows Kleven and Schultz and differs from Gruber and Saez, who define an income effect parameter in terms of the change in after-tax income. In the presence of multiple marginal tax rates – resulting in a kinked budget constraint – after-tax income is not the correct measure of an income effect, as it ultimately provides information on the average tax rate, not the marginal rate.

Substituting these into (4) produces

$$dz^j = \xi^{jj} \frac{d(1-\tau^j)}{1-\tau^j} z^j + \sum_{k \neq j}^{n} \xi^{jk} \frac{d(1-\tau^k)}{1-\tau^k} z^j + \eta^j \frac{z^j}{y} dy. \tag{5}$$

In order to get this into an estimable form, I divide both sides by z^j

$$\frac{dz^j}{z^j} = \xi^{jj} \frac{d(1-\tau^j)}{1-\tau^j} + \sum_{k \neq j}^{n} \xi^{jk} \frac{d(1-\tau^k)}{1-\tau^k} + \eta^j \frac{dy}{y},$$

and substitute the "change over level" terms for their approximate natural logarithmic approximations

$$\ln\left(\frac{z^j_{t+s}}{z^j_t}\right) = \xi^{jj} \ln\left(\frac{1-\tau^j_{t+s}}{1-\tau^j_t}\right) + \sum_{k \neq j}^{n} \xi^{jk} \ln\left(\frac{1-\tau^k_{t+s}}{1-\tau^k_t}\right) + \eta^j \ln\left(\frac{y_{t+s}}{y_t}\right). \tag{6}$$

The term ξ^{jj} is the uncompensated own-tax elasticity for income type j, η^j is the income elasticity, and s is some number of periods after time t. We expect the uncompensated own-tax elasticity to be positive, as the "price" variable is 1 minus the tax rate, and the income elasticity is negative assuming $\mathbf{z}$ are inferior goods. The compensated elasticity is a function of these two parameters and is ambiguously signed. Equation (6) is the basis of my estimation equation used in the ordinary income setting. The capital gains estimation framework modifies this substantially, for reasons alluded to in Section 2.2 (e.g. the dependent variable is mostly zeros).

Cross-Tax Elasticities

The simple theoretical model used in the derivation above assumes individuals evaluate the after-tax return to different income earning activities, and might respond to tax rate changes through a number of channels. These channels include altering income earning behavior in income types that did not experience a tax rate change. Such responses might involve actual reallocation of resources between different economic activities (i.e. a "real" economic response). Individuals may alter the amount of labor they supply in response to expected after-tax returns to savings vehicles eligible for long-term capital gains rates. Similarly, individuals may save more and ultimately realize more long-term capital gains in response to ordinary income tax changes.

Households also might respond through tax avoidance.[11] With only one income type,

[11] Responses that are non-compliant with tax law are also a possibility, though we might expect this would be reflected more in own-tax responses than cross-tax responses.

the returns to avoidance or evasion are increasing functions of tax rates. With multiple income types, the differential between income types is also important. Examples of avoidance activities between ordinary income and long-term capital gains include investing income earned by partnerships or Sub-chapter S corporations – which is passed-through and taxed at the individual level – in assets generating long-term capital gains. Another opportunity is available to those with home mortgages, whose interest are deductible for itemizers. Tax units can choose to invest in assets generating long-term capital gains as opposed to paying down their mortgage debt. Others include timing responses, such as delaying the realization of a short-term capital gain until it qualifies for preferential long-term rates. Higher capital gains tax rates might also increase contributions to savings vehicles taxed at ordinary income rates, such as traditional individual retirement arrangements (IRAs).

4 Data Sources and the U.S. Tax System

The primary source of data used in this paper is a non-public panel of federal income tax returns produced by the Statistics of Income (SOI) division of the Treasury Department. The panel is based on an income-stratified sample of tax filing units in 1999, and high income individuals are over-sampled (i.e. they are sampled at a higher rate). Each of the roughly 85,000 tax units is assigned a sample weight based on its strata, and in 1999 the sample represents a population of roughly 123 million tax returns. I extend the data back to 1997 by selecting returns for the primary filer in 1997 and 1998 with the same marital status as in 1999.

The resulting sample contains roughly 900,000 observations spanning tax years 1997 to 2007 prior to any sample restrictions. The panel includes information on ordinary and capital gains income items, as well as credits, deductions, exemptions, and any available demographic information. Weber and Bryant (2005) provide a detailed description of the panel, which has been updated annually since 2003.

Tax data do not contain any direct information on asset holdings, though they do include information on income or deductions related to capital asset holdings. Capital gains realizations, interest income, mortgage interest deductions, and dividend income all give an indication of the type and amount of assets held by a tax unit. I use an algorithm produced by Rob McClelland to impute unrealized capital gains levels using these variables and their counterparts in the 2001, 2004, and 2007 Surveys of Consumer Finance.

4.1 Income Definitions and Marginal Tax Rates

I use two definitions of income in the ordinary income portion of the paper. The first, broad income, is defined as total income from the Form 1040, less capital gains and gross Social Security income, plus tax exempt interest income. The second, taxable income, is defined as taxable income from the Form 1040, less capital gains and gross Social Security income.[12] Total income and taxable income differ primarily in that adjustments and deductions are excluded from taxable income, but not from total income. I follow most of the other papers in this literature by constructing a "constant law" measure of income. This is accomplished by including deductions in my measure of taxable income that were created or expanded during the sample period.

There are several important characteristics of taxable capital gains in the United States. First, capital gains are taxed upon realization, not accrual. Second, capital gains are generally placed into two bins: short-term capital gains (gains from the sale of an asset held less than one year) and long-term capital gains. Both are included in taxable income on the Form 1040, but long-term capital gains are separated from taxable income when calculating tax liability. This means that short-term gains are subject to the ordinary income marginal tax rate schedule, and long-term gains are generally subject to lower, preferential rates. Third, capital losses can only be deducted against ordinary income after all short-term and long-term capital gains have been exhausted, and only then at a maximum value of $3,000. Finally, net capital losses in excess of $3,000 can be carried forward and applied against future capital gains and future ordinary income, with a maximum annual deduction against ordinary income of $3,000, and an unlimited annual deduction when applied against capital gains.

An important part of any tax elasticity paper is estimating effective marginal tax rates. Effective rates often vary significantly from statutory rates – the rates actually written in law – because they take deductions, credits, phase-out regions for deductions and credits, income composition, and the alternative minimum tax into account. Estimating them requires a complicated Turbo-Tax-esque calculator at the state and federal levels, along with assumptions about the operative channel for responding to marginal tax rate changes. I follow Heim (2009) by assuming labor income is the operative channel of ordinary income response when labor income is the primary source of income, and assume business income is the operative channel when it is the primary source of income. The ordinary income tax

[12] These definitions follow Heim (2009). Auten, Carroll, and Gee (2008) define taxable income similarly, except they do not remove Social Security income.

rate includes payroll and state and federal income taxes. The state and federal marginal tax rate calculator I use is built and maintained by Jon Bakija (2009).

4.2 U.S. Federal Income Tax Rates

The motivation for this paper is the often substantial differential between effective long-term capital gains marginal tax rates and ordinary income marginal tax rates. Figure 1 presents the effective marginal tax rates on ordinary income (solid navy line) and long-term capital gains (dashed red line) using simulated data for a married household with one dependent living in a state without state-level individual income taxes in 2007. In all of these figures, marginal tax rates are censored at zero, and are calculated assuming no income of any other type. For example, when considering the navy line, $100,000 refers to $100,000 of ordinary income (in this case, wage income) and $0 of capital gains. Similarly, when considering the dashed red line line, $100,000 refers to $100,000 of long-term capital gains and $0 of ordinary income. [13]

Two aspects of this graph are striking. First, marginal taxes of both types are generally increasing, but are definitely non-monotonic functions of income. Phase-in and phase-out regions of credits and deductions, the alternative minimum tax, exemption phase-outs, and statutory marginal tax rate kinks cause effective rates to jump and fall. Second, tax rates on long-term capital gains are much lower than ordinary income rates for all but very low income levels (because the Child Tax Credit, for instance, is a function of "earned income" only). Figure 2 displays the differential between ordinary income rates and long-term capital gains rates, which ranges from around 11% to 21%, and exhibits substantial variation by income level.

4.3 The "Bush Tax Cuts": EGTRRA and JGTRRA

These data span two major federal tax reforms – the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) and the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) – along with several state level income tax reforms.[14] EGTRRA established a gradually decreasing path for marginal tax rates over time. JGTRRA sped the process up, fully enacting the tax cuts in 2003. See Auten, Carroll, and Gee (2008) for a

[13] Without censoring at zero the ordinary rates would be significantly negative at small income levels due to subsidies – ranging from 7.65 percent to 45 percent – found in the phase-in region of the Earned Income Tax Credit.

[14] The Taxpayer Relief Act of 1997 is also part of the data, but these data are only used as instruments or control variables as my preferred specifications include instruments constructed from lagged income.

detailed summary of the federal reforms as they relate to estimating elasticities of taxable ordinary income.

The reforms were large and expensive relative to the existing policy baseline, and there are several aspects that are important to keep in mind. First, between 2001 and 2003, statutory federal tax rates decreased in every bracket except the 15 percent bracket, most by around 3 or 4 percentage points, and a new 10 percent ordinary income bracket was created. Second, in 2003 capital gains rates were cut by 5 percent in both long-term capital gains brackets. Also, dividends earned from qualifying assets were made eligible for preferential long-term rates. Third, marriage penalties were reduced – essentially the tax brackets for married individuals were lengthened – and the child tax credit was gradually made more generous. Finally, the definition of taxable income was not seriously altered, with one exception: dividends received from assets qualifying for long-term capital gains rates (if sold) were subject to long-term capital gains rates, while "ordinary" dividends were subject to ordinary income rates.[15]

Figure 3 presents the effective ordinary income and long-term capital gains tax rates faced by a married tax unit with one dependent living in a state with no income taxes in 2000 and 2005. The thick navy and thick dashed red lines represent the effective marginal tax rates in 2000 for ordinary income and long-term capital gains, respectively. The thinner solid navy line and thinner dashed line represent the effective marginal tax rates in 2005 for ordinary income and long-term capital gains rates, respectively. The tax cuts cause the thinner lines – representing the 2005 effective tax rates – to fall below the solid lines for most income amounts in this range. This is highlighted in Figure 4, which displays the change in effective marginal tax rates for each income type directly. The size of the change varies with income, but with some exceptions the rates were lowered for most income levels.

The differential between long-term capital gains tax rates and ordinary income tax rates also changed, as shown in Figure 5. Cross-sectional variation in this differential is important for estimating cross-tax responses. If this differential was constant the treatment would be the same for all observations and identifying a cross-tax responses in this style would be impossible. A better set of performs would ideally involve directional changes for the two income types, in addition to changes in magnitude: for instance, capital gains rates increase while ordinary income rates decrease. Lacking changes in both rates, it might also be instructive to revisit past reforms which altered rates on one type of income but did not alter rates on the other.

[15] Heim (2009) and Auten, Carroll, and Gee (2008) do not remove dividends from their definitions of income. I follow their lead in my base case, but present robustness checks to excluding all dividends (ordinary and qualifying).

5 Ordinary Income Tax Elasticities

This section covers the estimation framework used to estimate own-tax and cross-tax ordinary income elasticities. I review the standard approach, and discuss how my preferred specification differs in light of Weber (2014a) and Weber (2014b), and the consideration of cross-tax responses.

5.1 Standard Ordinary Income Estimation Framework

What I will refer to as the "standard framework" for estimating ordinary income tax elasticities follows Gruber and Saez (2002) and Kopczuk (2005). It is a version of equation (6) limited to one income type (ordinary income) and some combination of base year and one period lagged income controls ($h(z_{it})$) to control for mean reversion or different income growth rates.

$$\ln\left(\frac{z_{t+s}}{z_t}\right) = \xi^u \ln\left(\frac{1-\tau_{t+s}}{1-\tau_t}\right) + \eta \ln\left(\frac{y_{t+s}}{y_t}\right).$$

Observations are at the tax unit level level, i, in year t. Two or three year differences are used (i.e. $s = 2$ or $s = 3$), which address individual fixed effects. I also include a vector of observable individual characteristics (both time-variant and time-invariant), X_{it}, and year fixed effects, α_t. The residual is $\ln(\nu_{it})$.

$$\Delta \ln(z_{it}) = \xi^o \Delta \ln(1 - \tau_{it}) + \eta \Delta \ln(y_{it}) + X_{it}'\beta + \alpha_t + h(z_{it}) + \Delta \ln(\nu_{it}). \tag{7}$$

The coefficient on the log net-of-tax-rate, ξ^o, is the uncompensated elasticity of ordinary taxable income and the coefficient on virtual income, η, is the income elasticity.

Marginal tax rates τ are functions of taxable income in a progressive tax system, which means the net-of-tax rate is an endogenous variable. As a result, ordinary least squares estimation (OLS) of the coefficients in this equation would have a negative sign, suggesting higher tax rates cause higher income.

Two-stage least squares estimation is used to address the endogeneity problem, with simulated instruments constructed using "predicted" net-of-tax rates holding income constant at base year levels.[16] The term $\tau_{it}^{P|Z_{it}}$ represents the predicted or simulated marginal tax rate in year t for individual i, with income held constant at the base year level used to estimate

[16] The base year refers to the earlier year in a difference equation. That is, if using 3 year lagged differences the base year is t and the forward year is $t + 3$.

the marginal tax rates.

$$\Delta \ln(1-\tau_{it}^{P|Z_{it}}) = \ln(1-\tau_{it+s}^{P|Z_{it}}) - \ln(1-\tau_{it}^{P|Z_{it}})$$

5.2 Baseline Estimates and Modifications

To establish baseline results I replicate Heim (2009). Heim follows the standard framework, but also abstracts away from income effects (i.e. assumes $\eta = 0$).[17] Heim uses the same set of data that I use here, and also uses the same marginal tax rate calculator (Bakija, 2009). Heim's preferred specification – which includes base year income weights – produces own-tax ordinary income elasticity estimates of 0.4, but Heim and Mortenson (2016) reproduce these results with a correction to the definition of taxable income and find estimates indistinguishable from zero.[18] These are my baseline results, but I make a series of changes to the standard estimation framework, mostly following Weber (2014a) and Weber (2014b).

Instrument Selection

The two necessary properties of a valid instrument z_{it} are relevance and exogeneity. Relevance refers to the property that the instrument is sufficiently correlated with the endogenous variable ($cov[\Delta z_{it}, \Delta \ln(1-\tau_{it})|X_{it}] \neq 0$). Exogeneity requires that the instrument is uncorrelated with the error term, conditional on the other covariates ($cov[\Delta z_{it}, \Delta \ln(\nu_{it})|X_{it}] = 0$).

Instruments constructed following Auten and Carroll (1999) or Gruber and Saez (2002) typically satisfy empirical tests of relevance (e.g. F-test statistics on the first stage regression results are large), but are not exogenous (Weber, 2014b). This is because shocks to base year income ($\ln(\nu_{it})$), which would directly influence the predicted marginal tax rates, are also found in the error term of the estimation equation ($\Delta \ln(\nu_{it})$). Weber proposes a set of approximately exogenous simulated instruments, where predicted net-of-tax rates are estimated holding income constant at an inflation-adjusted level some n years prior to the base year income:

$$\Delta \ln(1-\tau_{it}^{P|Z_{it-n}}) = \ln(1-\tau_{it+3}^{P|Z_{it-n}}) - \ln(1-\tau_{it}^{P|Z_{it-n}}) \tag{8}$$

In Weber's specification income shocks can be serially correlated and the instruments will

[17] Gruber and Saez (2002) estimate income effects, but many papers do not.

[18] Heim (2009) includes short-term and long-term capital gains in his definition of income by mistake. See Heim and Mortenson (2016) for a more detailed description of the replication.

remain approximately exogenous so long as the number of lags (n) is sufficiently large. The bias remaining from serially correlated transitory income shocks is decreasing in the number of periods before the base year.[19] A standard F-test of the first-stage estimates can be used to ensure instruments are sufficiently relevant, and Weber uses a difference-in-Sargan test to estimate whether instruments lagged n periods are exogenous (assuming instruments lagged $n+1$ or $n+2$ periods are exogenous).

My preferred instruments for ordinary income and capital gains tax rates when estimating elasticities in the ordinary income framework (i.e. the dependent variable is the log change in ordinary income) are constructed using two and three period lagged income, so long as difference-in-Sargan tests are satisfied. The variation in marginal tax rates over time and within a given year associated with both state and federal reforms – as well as the variation provided by the deductibility against federal taxable income of state and local income taxes – enters through these instruments and is used to identify elasticity estimates.

Virtual Income

Constructing a good approximation of virtual income, y_{it}, is challenging given multiple income types and the limited deductibility between capital income and ordinary income. I define virtual income in year t for individual i to be the sum of wage income times the wage income marginal tax rate $z^w_{it}\tau^w_{it}$, business income times its tax rate $z^b_{it}\tau^b_{it}$, gross taxable income less wage, business, and capital gains income times the interest income tax rate $z^x_{it}\tau^x_{it}$, the maximum of net long-term capital gains and -\$3,000 times its tax rate, and the maximum of net short-term capital gains and -\$3,000 times its tax rate; less the sum of federal ($T^F(z_{it})$), state ($T^S(z_{it})$), and payroll taxes ($T^P(z^w_{it})$).

$$y_{it} = z^w_{it}\tau^w_{it} + z^b_{it}\tau^b_{it} + z^x_{it}\tau^x_{it} + \max(z^c_{it}, -\$3,000)\tau^c_{it} + \max(z^k_{it}, -\$3,000)\tau^k_{it} - \left(T^F(z_{it}) + T^S(z_{it}) + T^P(z^w_{it})\right)$$

As virtual income is a function of marginal tax rates, it is also endogenous. Instruments for virtual income are constructed by simulating the tax rates used in the equation above using lagged base year income. Similarly, the income amounts are adjusted for inflation to match

[19] Weber (2014b) finds that using approximately exogenous instruments constructed using lagged income increases elasticity estimates surrounding the 1986 Tax Reform Act from 0.3 to 0.9.

the price level in the simulated year.[20]

Base Year Income Controls

I include a function of income as a control ($h(\mathbf{z})$), which is standard in the literature. Income controls are meant to address two problems. First, transitory income shocks might dissipate over time, generating mean reversion. If this is the case, individuals with high (low) income in the base year might see incomes fall (rise) in the forward year, independent of tax reforms. This could bias estimates if the change in tax rates varies with income. Second, individuals at different sections of the income distribution might have different income growth rates, again, independently of tax reforms. Controlling for varying growth rates at different levels of income will help to mitigate both biases. In my preferred specification, $h(\mathbf{z})$ takes the form of a 10 piece spline in income lagged two and three periods. Note that splines constructed using base year income - the standard approach in this literature - are endogenous (Weber, 2014b).

Treatment Definition

Weber makes a different point in another paper (Weber, 2014a), namely that the definition of "treatment" used in the ordinary income literature – the log change in the actual tax rate faced by a tax unit – is measured with error. Weber (2014a) terms this as "treatment mis-measurement." In particular, individuals might respond across kinks in the effective marginal tax rate schedule for a number of reasons, including optimization frictions and income volatility. Weber demonstrates that a causal intent-to-treat effect (ITT) can be estimated under the assumption that the instruments used to address the endogeneity of the treatment are independent of secular income trends and transitory income shocks.

Estimating a causal average treatment effect requires the additional assumption that instruments are independent of any incentives to cross kinks. Given the number of "brackets" in the effective rate schedule (e.g. see Figure 1) and the complexity involved in estimating effective marginal rates, this is a valid concern. The practical difference between an estimable average treatment effect in this setting – what Weber terms a "fixed bracket average treatment effect' (FBATE) – and an ITT effect is in the definition of treatment. An FBATE uses

[20] Because effective marginal tax rates are non-monotonic functions of taxable income (e.g. see Figure 1) virtual income is negative for some individuals. This results in these observations being dropped, as virtual income enters into the regression equation in logs. The exact number depends on the specification, but comparing Tables 2 and 3 suggests between 40,000 and 60,000 observations are dropped when virtual income is included as an endogenous regressor.

the log change in the actual tax rate faced by a tax unit, while an ITT uses the predicted log change in tax rates holding base year income constant. I present both FBATE and ITT estimates, though my preferred specification is an ITT estimate. I also use analogous definitions of treatment for virtual income.

Preferred Specification

Equation (9) represents my base specification in the ordinary income setting. It includes the log of net ordinary income ($\ln(1-\tau^o_{it})$) and long-term capital gains ($\ln(1-\tau^c_{it})$) tax rates as endogenous regressors. The log change in virtual income ($\Delta \ln(y_{it})$) is also endogenous. To address this endogeneity I use an analogously constructed set of instruments for each variable, namely predicted changes using multiple years of lagged income. In my preferred specification all three endogenous variables enter as predicted changes holding income constant in the base year. The estimates are weighted by the probability of being sampled, and no income weights are applied.[21]

$$\Delta \ln(z^o_{it}) = \xi^{oo}\Delta \ln(1-\tau^o_{it}) + \xi^{oc}\Delta \ln(1-\tau^c_{it}) + \eta\Delta \ln(y_{it}) + X'_{it}\beta + h(\mathbf{z})'\sigma + \Delta \ln(\nu_{it}) \quad (9)$$

I make several restrictions to the sample, all of which follow the existing literature. First, I drop observations whose marital status changes between the base year and forward year, or any relevant lagged year used to construct instruments or base year income controls. This is done to ensure that income changes are not largely the result of changes in household structure. Second, I limit my estimation sample to those with broad income in excess of \$10,000 in the base year. In practice this is not a binding constraint for most tax units who file tax returns. Third, I drop observations with primary filers aged less than 25 or older than 100 in the base year, in an attempt to reduce the influence of college or end-of-life decisions. Fourth, households without valid zip codes are dropped, as state marginal tax rates are used. Finally, I drop observations who died in a given tax year or have sample weights of zero.

Control variables include number of children, age, age-squared, and dummy variables for business income, itemizer status, and region. All regressions in this section include year fixed effects. Errors are clustered at the tax unit level. The data used to construct the

[21] Weighting estimates using base year income is also problematic: shocks to base year income are correlated with shocks to the dependent variable. A tax unit receiving a large positive (negative) transitory income shock should expect the shock to dissipate in the forward year, biasing estimates associated with tax decreases downward (upwards). This has a net effect of biasing estimates towards zero.

dependent and independent variables (as opposed to the controls and lagged instruments) are limited to the years 2000 to 2004 to ensure similar data are used in all specifications. Table 1 displays the mean values and associated standard errors of dependent variables, independent variables, and marginal tax rates.

5.3 Implementing My Preferred Specification

Three features of the standard approach are almost certainly invalid and have the potential to bias estimates: instruments constructed using base year income, income controls constructed using base year income, and base year income weights. Instead, I construct instruments using lags of base year income; I construct income controls (10 piece splines) using income lagged two and three periods; and I opt not to use any income weights. I refer to this specification as "Heim's modified specification."

Three other specification decisions are more a matter of opinion, and Table 2 contains coefficient estimates meant to establish the sensitivity of results to these choices. First, Heim's data cover the base years 2000, 2001, and 2002, as these were the most recent data available at the time of publication. I add base years 2003 and 2004. Second, Heim's preferred specification uses three year differences; I try two year differences. I am motivated to make this change because the measurement error associated with the "treatment" variable – the change in tax rates between years – could be increasing in the number of years used for differencing. A two-year difference might allow the tax unit time to learn about the tax change, but is hopefully not so long that the household hasn't changed to such a degree as to weaken the definition of treatment. Third, my preferred specification replaces the definition of treatment traditionally used in this literature – the actual, realized change in tax rates between year t and year $t + 2$ – with the predicted change holding income constant in year t, capturing an ITT effect.

Table 2 presents coefficient estimates, with standard errors in parentheses, from the second stage of a two-stage least squares regression. The log change in ordinary income is the dependent variable, which means the coefficients associated with the net-of-tax rates, $\Delta \ln(1-\tau^o)$, can be interpreted as estimates of uncompensated own-tax elasticities of ordinary income. Note that the expected sign of the elasticity is positive, as the "price" variable is 1 *minus* the marginal tax rate. Higher marginal tax rates will cause the net-of-tax rate to decline, and we expect individuals to reduce income in response to higher tax rates, ceteris paribus.

I begin by testing the validity of instruments. In particular, I test how many lags are necessary to reject the null hypothesis of a difference-in-Sargan test of whether the instrument constructed using the most recent year's income is exogenous. Each column in Table 2 contains a modified version of Heim's specification. I substitute splines in base year income for splines in two-period and three-period lagged gross income income, and drop base year income weights in favor of sample weights. Three year differences are used, data years are 2000, 2001, and 2002, and the definition of treatment is the *actual* realized change in net-of-tax rates.

Column 1 uses instruments constructed using base year income. The coefficient estimate is 0.074, with approximately the same standard error. Column 2 uses instruments constructed using base year and two and three periods lagged income, allowing for a test of whether instruments constructed using base year income are exogenous (assuming other excluded instruments are exogenous). The p-value on the difference-in-Sargan test is 0.41, meaning I cannot reject that the instrument constructed using base year income is exogenous.[22] The coefficient and standard errors are unchanged after including the two additional excluded instruments.

Column 3 uses instruments constructed using 1 year, 2 year, and 3 year lagged income. The p-value is 0.51, again meaning that we cannot reject that simulated instruments constructed using one period lagged income is exogenous. The coefficient estimate is 0.21 – in the range of other elasticity estimates in this time period – but the standard error is 0.29. Column 4 uses instruments constructed using two year and three year lagged income. The p-value is 0.90.[23] Again, the coefficient and standard error are approximately the same: 0.43 and 0.45, respectively.

Failing to reject that instruments constructed using base year income are exogenous is surprising given Weber's empirical and analytical results.[24] Weber demonstrates that instruments constructed from base year income are endogenous, and that instruments constructed using one period lagged income are also endogenous in the presence of moderately serially correlated income shocks. Ultimately, I remain convinced by Weber's analytical results, and choose to use instruments constructed from income lagged two and three years prior to the base year.[25]

Table 3 provides a sense of how my three changes to "Heim's modified specification"

[22]No difference-in-Sargan test is performed in Column 1 because only one excluded instrument is used.

[23]First stage F-test statistics are reported in the table and do not suggest weak instruments are an issue here.

[24]Of course, failing to reject a null is different than proving the null to be true.

[25]I will continue to employ difference-in-Sargan tests in specifications with only one endogenous variable and at least two excluded instruments.

– two year differences, additional years of data, and an alternate definition of treatment – affect own-tax elasticitiy estimates.[26] Column 1 is identical to Column 4 in Table 2, and is Heim's modified specification. Column 2 uses two year differences instead of three, holding the other decisions equal. Column 3 includes years 2003 and 2004, but is otherwise identical to Heim's modified specification. Column 4 uses the intent-to-treat definition of treatment, but is again otherwise similar. Column 5 uses the extra data and two year differences, but the standard definition of treatment. Column 6 uses the extra data and the intent-to-treat estimator, but three year differences. Column 7 uses two year differences and the intent-to-treat estimator, but data only from 2000, 2001, and 2002. Finally, Column 8 uses the extra data, two year differences, and the alternate definition of treatment. Ex ante, Column 8 is my preferred specification.

This table suggests own-tax ordinary income elasticity estimates in the style of Weber (2014a & 2014b) are indistinguishable from zero. The estimates have the correct sign in each specification, but are imprecise, with standard errors ranging from 0.25 to 0.45. Because of this, all of the point estimates in this table are consistent with other findings in this literature, but are also consistent with elasticities of zero.[27]

Two of the specification decisions have clear patterns. Two year differences yield smaller estimates: the set of estimates using two year differences in columns 2, 5, 7, and 8 is strictly less than the set using three year differences in columns 1, 3, 4, and 6. This suggests tax units require several periods to respond, as opposed to only two. The ITT estimates in columns 4, 6, 7, and 8 have strictly smaller standard errors than the ATE estimates in columns 1, 2, 3, and 5. This is consistent with (Weber, 2014a), who finds that ITT estimates are more precise than ATE estimates. Finally, adding additional data seems to have a smaller effect than the other two choices: some estimates are smaller, some larger; some more precise, some less.

5.4 Ordinary Income Elasticity and Income Effect Estimates

This section incorporates the possibility of cross-tax responses and income effects. I do not have strong priors regarding the estimates produced in my preferred specification. Three papers estimate own-tax ordinary income elasticities using the Bush Tax Cuts, with estimates ranging from zero to 0.4 (Auten, Carroll, & Gee, 2008; Singleton, 2011; Heim & Mortenson,

[26]Instruments are constructed from income lagged 2 and 3 periods are used in all specifications in this table, and throughout the remainder of the ordinary income section unless otherwise noted.

[27]The F tests of weak instruments and difference-in-Sargan tests do not suggest a problem in either dimension.

2016). However, Heim and Mortenson and Auten, Carroll, and Gee use invalid instruments to address the endogeneity of marginal tax rates. Singleton uses a novel set of earnings data matched with Current Population Survey data, but focuses exclusively on married tax units near the kink point between 15 and 27 percent. Similarly, the only existing cross-tax estimates in the U.S. don't account for potentially important sample selection issues, and the only estimates from outside the U.S. are from Denmark (and, again, the instruments used are likely invalid).

Incorporating Income Effects

Table 4 is a recreation of Table 3, with the addition of the log change in virtual income as an endogenous regressor. The coefficient associated with this variable is an income elasticity, and is expected to have a negative sign. It mimics the form of the ordinary income tax rate, entering as the actual change in log virtual income in columns 1, 2, 3, and 5, and as an ITT in columns 4, 6, 7, and 8.[28]

The results in Table 4 do not tell a nice story. First, none of the coefficients of interest are distinguishable from zero. Second, while all of the income effect point estimates have the expected sign (negative), three of the ordinary income point estimates have an unexpectedly negative sign. Further, the standard errors in Table 4 are strictly larger – in some cases much larger – than those in Table 3. This could be the result of fewer observations (many observations have negative virtual income and are dropped) or collinearity between the virtual income and ordinary income tax variables. These findings are consistent with a large degree of measurement error in the construction of virtual income, and argue against their inclusion in future specifications.

Incorporating Cross-Tax Effects

Table 5 is a recreation of Table 3, with the addition of the log change in long-term capital gains as an endogenous regressor. The coefficient associated with the capital gains tax rate is a cross-tax elasticity, and is expected to have a negative sign. It mimics the form of the ordinary income tax rate, entering as the actual change in log long-term marginal tax

[28] In specifications excluding income effects and cross-tax effects - such as those in Table 2 - I am able to test the exogeneity assumption for ordinary income instruments using a difference-in-Sargan. This test is not valid in the presence of multiple endogenous variables, and since all regressions reported here include at least two endogenous variables I do not perform the test.

rates in columns 1, 2, 3, and 5, and as an ITT in columns 4, 6, 7, and 8.

Table 5 suggests ordinary income decisions are responding to long-term capital gains taxes in the expected direction. All of the coefficients associated with the cross-tax variables are negative, which indicates that higher long-term capital gains tax rates are associated with higher ordinary income realizations (remember that the variable is the log change in 1 minus the tax rate). Further, in all of the columns with three year differences (1, 3, 4, and 6) I can reject the null hypothesis of no cross-tax responses at a 5 percent significance level. The magnitudes of the statistically significant estimates range from perhaps implausibly large (-2.4) to reasonable (-0.77), and are suggestive of substantial cross-tax responses.

In all of the columns with three year differences (1, 3, 4, and 6) the ordinary income own-tax elasticities are distinguishable from zero, but also contain some perhaps implausibly large results. The estimates in columns 1 and 3 suggest increases in the net-of-tax rate of 10% (for example, if marginal tax rates change from 30% to 23%) are associated with increases in ordinary income of 13% or more. The estimates in columns 4 and 6 – which are ITT effects – are more reasonable, with own-tax and cross-tax elasticities of around 0.8. This table again suggests that three year responses are more substantial than two and that ITT estimates are more precisely estimated.

Table 6 is a re-creation of Table 3, with the addition of the log change in virtual income and long-term capital gains rates as endogenous regressors. Once again, they mimic the form of the ordinary income tax rate. Recall that we expect the sign of the own-tax elasticity to be positive, the cross-tax elasticity to be negative, and the income elasticity to be negative. Unsurprisingly, these results are qualitatively a mix of those in Tables 4 and 5. The cross-tax and virtual income elasticity estimates have the expected sign in each specification, and the cross-tax estimates produced using three year differences are large and statistically significant. The own-tax elasticities have the expected sign in all specifications except Column 2, though most of these estimates are statistically insignificant.

Relevant Sub-Populations

Of course, own-tax and cross-tax elasticities may be heterogeneous. Households vary in their asset holdings, income, and tax-system information sets. Also, while many tax units have positive (nominal) accrued capital gains in a given year, relatively few actually sell those assets in a given year (*realizing* taxable capital gains). With this in mind, Table 7 presents own-tax, cross-tax, and virtual income elasticities, with clustered standard errors in parentheses, for sub-populations (selected ex ante) that might be particularly responsive to own-tax or cross-tax changes. I use the same regression specification – three year differences with the full set of data and an ITT definition of treatment – to produce the coefficients estimated in this table.

The first two rows of Table 7 display estimated elasticities using base-year broad income floors of $50,000 or $100,000 (i.e. income in year t must be at least $50,000). Row 3 contains estimates performed on the population of individuals with non-zero short-term or long-term capital gains in either the base or forward year, and at least $10,000 of broad income in the base year. Row 4 is similar, only those with interest or dividend income are included. Row 5 limits the sample to those with pass-through income (i.e. income from partnerships or Sub-Chapter S-Corporations). Row 6 proxies for tax-payer knowledge by limiting the sample to those returns with a non-zero itemized deduction for "paid tax preparer."

Itemizers with paid preparers are the only responsive sub-sample in these regressions. Their own-tax and cross-tax elasticities are statistically significant and extremely large, suggesting paid preparers are improving the information set of tax units or are assisting with avoidance activities. The remainder of the sub-populations do not produce any statistically significant point estimates for our variables of interest. In addition, the standard errors are extremely large in most specifications. This suggests collinearity is an issue, which is unsurprising given that sub-samples might exhibit less cross-sectional variation both within and between different tax rate types.

6 Capital Gains Tax Elasticities

Now I consider the effect of ordinary income and long-term capital gains tax rates on long-term capital gains realizations. This literature is much smaller, with only three studies estimating capital gains elasticities in the United States in the past twenty years (Burman & Randolph, 1994a; Auerbach & Siegel, 2000; Dowd et al., 2015). Recall that the capital gains estimation equations reflect two aspects of capital gains in the United States that are not issues in the ordinary income setting. First, *realizations* are taxed, not accruals. Second, the majority of tax units do not have any realized long-term capital gains in a given year. An individual is assumed to first determine whether to realize capital gains (I_{it}^*), then the level of capital gains realizations (g_{it}). These two decisions are estimated in a Generalized Tobit framework following Lee, Maddala, and Trost (1980).

6.1 Long-term Capital Gains Income Estimation Equations

In this section I outline the capital gains approach. The procedure for estimating this system of equations involves four steps, as adapted to this context by Burman and Randolph and most recently implemented by Dowd et al. First, the current (τ_{it}^c) and future (τ_{it+1}^c) marginal tax rates are replaced with fitted values, generated by regressing those variables on two excluded instruments – first dollar tax rate and highest combined state and federal rate – and the remaining control variables. Second, equation (10) is estimated by Probit on the full sample. The dependent variable, I_{it}^*, is a binary variable representing whether a net positive long-term capital gains realization took place in year t.[29] The estimated coefficients in equation (10) are used to construct the Inverse Mills Ratio (λ_{it}). Third, the fitted values for the current and future marginal tax rates are re-estimated on the sub-sample of observations with positive net realized long-term capital gains, and the Inverse Mills Ratio (IMR) is included as a regressor. Fourth, equation (11) is estimated by OLS on the sub-sample, where the dependent variable, $\ln(g_{it})$, is the log-level of net long-term gains from the sale of capital assets. Standard errors are calculated using a standard bootstrapping technique, and a dummy variable for the existence of carryover losses is used as an exclusion restriction between the criteria and level equations.

Here are the criteria and level equations, taken (with modification) from Dowd et al.:

$$I_{it}^* = \alpha_1 \widehat{\tau_{it}^c} + \alpha_2 \widehat{\tau_{it-1}^c} + \alpha_3 \widehat{\tau_{it+1}^c} + X_{it}' \alpha_4 + \gamma_{1it} \tag{10}$$

$$\ln(g_{it}) = \beta_1 \widehat{\tau_{it}^c} + \beta_2 \widehat{\tau_{it-1}^c} + \beta_3 \widehat{\tau_{it+1}^c} + X_{it}' \beta_4 + \widehat{\lambda_{it}} + \gamma_{2it} \tag{11}$$

In both equations, the marginal long-term capital gains tax rate for individual i at time t is denoted τ_{it}^c, vectors of control variables are denoted X_{it}, and the error term is denoted γ_{it}. Hats denoted fitted values. The control variables include demographic, wealth, and income information. The α and β parameters are coefficients associated with the regressors.

I modify the standard approach by including the ordinary income tax rates for the previous, current, and next years as right hand side variables in both the level and criteria equations (e.g. τ_{it}^o). I instrument for the endogenous ordinary income tax rates (i.e. the current and future year tax rates) in the capital gains estimation equations using predicted

[29] Specifically, the variable used is from line 9 on the Form 1040 Schedule D: net long-term gains or losses from the sale of a capital asset. This variable is *prior* to applying any carry-over losses or contemporary losses from short-term transactions.

tax rates based on previous year's income.[30]

Equations (12) and (13) are my baseline specifications in the capital gains setting:

$$I^*_{it} = \alpha_1^{cc}\widehat{\tau^c_{it}} + \alpha_2^{cc}\widehat{\tau^c_{it-1}} + \alpha_3^{cc}\widehat{\tau^c_{it+1}} + \alpha_1^{co}\widehat{\tau^o_{it}} + \alpha_2^{co}\widehat{\tau^o_{it-1}} + \alpha_3^{co}\widehat{\tau^o_{it+1}} + X'_{it}\alpha_4 + \gamma_{1it} \quad (12)$$

$$\ln(g_{it}) = \beta_1^{cc}\widehat{\tau^c_{it}} + \beta_2^{cc}\widehat{\tau^c_{it-1}} + \beta_3^{cc}\widehat{\tau^c_{it+1}} + \beta_1^{co}\widehat{\tau^o_{it}} + \beta_2^{co}\widehat{\tau^o_{it-1}} + \beta_3^{co}\widehat{\tau^o_{it+1}} + X'_{it}\beta_4 + \widehat{\lambda_{it}} + \gamma_{2it} \quad (13)$$

To be clear, τ^c_{it} is the long-term capital gains tax rate for individual i in tax year t, and τ^o_{it} is the analogous ordinary income tax rate. The coefficients with repeated superscripts are "own-tax;" differing superscripts are "cross-tax." The own-tax "persistent" elasticity is calculated as originally derived by Burman and Randolph (1994b), and followed by Auerbach and Siegel and Dowd et al.:

$$\widehat{\tau^c_{it+1}}[\beta_1^{cc} + \beta_2^{cc} + \beta_3^{cc} + (\alpha_1^{cc} + \alpha_2^{cc} + \alpha_3^{cc})\widehat{\lambda_{it}}]$$

The own-tax "transitory" elasticity is calculated in an analogous manner, dropping the coefficients associated with future and lagged tax rates. Cross-tax elasticities are calculated analogously to their own-tax counterparts, swapping τ^c_i for τ^o_i, and α^{cc} and β^{cc} for α^{co} and β^{co}.[31] All elasticities are weighted by the product of the size of net long-term gains realized (before deducting any applicable carryover losses from previous years) and the sample weight.

Sample restrictions in this setting are similar to those in the ordinary income setting. The primary difference is that I drop observations with negative long-term capital gains tax rates (of which there are very few), and I expand my analysis to 2000 to 2006. I control for non-tax factors relevant to capital gains realization decisions using a number of variables, including several imputed variables. The log of lagged permanent and transitory income are imputed using regressions of average income in the sample on demographic characteristics. Log unrealized capital gains are imputed from the SCF. The log of lagged business losses and rent losses, along with analogous dummy variables, control for shocks to entrepreneurial income. The number of short term transactions – meant to control for the sophistication of the household – enter in five separate bins, ranging from 1 to 34 transactions (75th percentile) to 1,002 or above (99th percentile). I also include a marriage dummy, number of children, and five year age bins of the primary filer.

[30] This is similar to the approach in the ordinary income setting, except the treatment and instruments are in levels, not differences.

[31] A negative own-tax elasticity in this setting suggests higher capital gains tax rates lower capital gains realizations. Elasticities in the ordinary income setting have the opposite sign because the $1-\tau$ is used to construct elasticities in the ordinary income setting.

Table 6 displays means and standard errors for the variables used in this setting for the full sample and the sub-set of tax units reporting positive net long-term capital gains realizations ("realizers"). Only 7.5% of the weighted sample are realizers. This compares to roughly 17% of the unweighted sample, which is a consequence of the panel's over-sampling of high-income individuals. Realizers are also on average older, more likely to be married, and have fewer children.

All of the regression tables in Section 7 contain results from the second and fourth steps: the criterion equation regression (Equation 12) and the level equation regression (Equation 13). Columns 1 and 3 are always the criterion equation estimates, and columns 2 and 4 are always the level equation estimates.

6.2 Capital Gains Tax Elasticity Estimates

Table 7 presents the coefficient estimates, with standard errors (calculated using a standard boot-strapping technique) in parentheses, from the criterion and level equations with and without cross-tax rates. I begin by abstracting away from cross-tax and inter-temporal effects; that is, I assume all ordinary income cross-tax effects are zero as well as the coefficients on lagged and future capital gains tax rates. Columns 1 and 2 are the criterion and level equations when the only tax variable included is the current period capital tax rate. Columns 3 and 4 re-estimate columns 1 and 2 with the addition of the current period ordinary income tax rate.

The tax coefficients match my priors in every case. Current period capital taxes are negatively correlated with capital gains realizations and the amount of realizations. Similarly, higher ordinary income taxes in the current period are associated with a greater probability of realizing a capital gain, and also larger capital gains. All of the elasticity estimates have the correct sign, and are plausible given the broad range of prior transitory estimates. The coefficients associated with the inverse mills ratios in each setting are significantly different from zero, suggesting a "selection" issue is relevant here. Similarly, the exclusion restriction – the existence of carryover losses in excess of $3,000 – is relevant for realization decisions.

Columns 1 and 2 of Table 8 closely follow Dowd et al., and includes the future and lagged tax rates as explanatory variables. This specification involves two endogenous variables, the current and next period tax rates, and both are fitted prior to estimating the criterion and level equations. The coefficient estimates in this setting do not match my priors, with the exception of the lagged tax rate. The transitory elasticity reflects this: it has the wrong sign and is imprecisely estimated. The persistent elasticity, however, is extremely close to that estimated by Dowd et al., -0.899, and is statistically significantly different from zero.

Columns 3 and 4 of Table 8 add current, future, and lagged ordinary income tax rates to the mix. The coefficients associated with these variables have the correct sign, except the next period tax rate in the level equation. The resulting persistent cross-tax elasticity estimate is 2.774, with a standard error of 1.233. This is statistically significantly different from zero at a 5 percent level. The transitory elasticity is imprecisely estimated, with a standard error over 5. Including the cross-tax rates flips the signs of the current period capital gains tax rate, and the persistent elasticity is much larger in this case (-2.438). The transitory capital gains elasticity remains insignificant, however.

7 Conclusion

My paper's primary contribution is to estimate cross-tax rates between long-term capital gains income and ordinary income in the United States. The tax system in the United States differs in several ways from the only other country in which cross-tax elasticities have been estimated (Denmark) and there are many reasons to think the elasticities might differ.[32] I make several other contributions as well.

Most notably, I apply the findings of Caroline Weber's (2014b) work on consistent elasticity of taxable income estimation to a new time period and new set of data. These include constructing instruments for ordinary income that are less likely to be endogenous than instruments constructed following Gruber and Saez (2002), and employing more appropriate base year income controls and income weights.

I find that in the standard framework, ignoring cross-tax effects of capital gains, ordinary income elasticities of taxable income are indistinguishable from zero in the context of the Bush Tax Cuts. These estimates indicate we cannot reject that the tax cuts had non-negligible effects on individual taxable income earning patterns.

When incorporating cross-tax effects I find that estimated ordinary income responses to capital gains taxes are large and statistically significant in some cases and are imprecisely estimated in others. The own-tax estimates – the responsiveness of ordinary income to ordinary income tax changes – similarly vary in size and statistical significance. I explore the responsiveness of various sub-samples that might be more responsive ex ante, and find that those with paid preparers respond to a much larger degree. I also find statistically

[32] Kopczuk (2005) establishes that individuals respond to changes in the definition of income, which makes any cross-country comparisons challenging given that income definitions, avoidance opportunities, and tax enforcement likely vary in myriad ways.

significant responses by long-term capital gains realizations to ordinary income taxes. Own-tax capital gains responses are also large, which is in keeping with existing work.

Evidence suggesting individuals respond to tax rates across income types by altering income earning or reporting activities has consequences for estimates of revenue and welfare consequences of taxation. To the extent individuals respond across income types, the excess burden and behavioral revenue losses from marginal tax rate increases on a given type of income might not be as large as own-tax elasticities alone would suggest. Similarly, the excess burden reductions and behavioral revenue gains associated with marginal tax decreases could be smaller. This is because income flowing from one income type to another increases in the excess burden or revenue of one income type and decreases with the other. This partially offsets both effects.

References

Auerbach, Alan J. and Jonathan M. Siegel (2000), "Capital gains realizations of the rich and sophisticated." 90(2), 276–82.

Auten, Gerald E. and Robert Carroll (1999), "The effect of income taxes on household income." *Review of Economics and Statistics*, 81(4), 681–693.

Auten, Gerald E., Robert Carroll, and Geoffrey Gee (2008), "The 2001 and 2003 tax rate reductions: An overview and estimate of the taxable income response." *National Tax Journal*, 61(3), 345–64.

Auten, Gerald E. and Laura Kawano (2011), "When tax rates go up: Taxpayer responses to the 1993 act." Unpublished.

Bakija, Jon (2009), "Documentation for a comprehensive historical U.S. federal and state income tax calculator program." Unpublished.

Bastani, Spencer and Håkan Selin (2014), "Bunching and non-bunching at kink points of the Swedish tax schedule." *Journal of Public Economics*, 109(C), 36–49.

Burman, Leonard E. and William C. Randolph (1994), "Measuring permanent responses to capital gains taxes in panel data." *American Economic Review*, 84(4).

Burns, Sarah K. and James P. Ziliak (2015), "Identifying the elasticity of taxable income." *Economic Journal*, Forthcoming.

Chetty, Raj (2012), "Bounds on elasticities with optimization frictions: A synthesis of micro and macro evidence on labor supply." *Econometrica*, 80(3), 969–1018.

Chetty, Raj, John N. Friedman, Tore Olsen, and Luigi Pistaferri (2011), "Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records." *The Quarterly Journal of Economics*, 126(2), 749–804.

Chetty, Raj and Emmanuel Saez (2005), "Dividend taxes and corporate behavior: Evidence from the 2003 dividend tax cut." *The Quarterly Journal of Economics*, 120(3), 791–833.

Dowd, Tim, Robert McClelland, and Athiphat Muthitacharoen (2015), "New evidence on the tax elasticity of capital gains." *National Tax Journal*, 68(3), 511–44.

Feldstein, Martin (1995), "The effect of marginal tax rates on taxable income: A panel study of the 1986 tax reform act." *Journal of Political Economy*, 103(3), 551–572.

Giertz, Seth (2007), "The elasticity of taxable income over the 1980s and 1990s." *National Tax Journal*, 60(4), 743–68.

Giertz, Seth (2010), "The elasticity of taxable income during the 1990s: New estimates and sensitivity analyses." *Southern Economic Journal*, 77(2), 406–33.

Gruber, Jonathan and Emmanuel Saez (2002), "The elasticity of taxable income: Evidence and implications." *Journal of Public Economics*, 84(1), 1–32.

Heim, Bradley T. (2009), "The effect of recent tax changes on taxable income: Evidence from a new panel of tax returns." *Journal of Policy Analysis and Management*, 28(1), 147–63.

Heim, Bradley T. and Jacob A. Mortenson (2016), "A comment on 'The effect of recent tax changes on taxable income: Evidence from a new panel of tax returns'." *Journal of Policy Analysis and Management*, Forthcoming.

Kawano, Laura (2014), "The dividend clientele hypothesis: Evidence from the 2003 Tax Act." *American Economic Journal: Economic Policy*, 6(1), 114–36.

Kleven, Henrik J. and Mazhar Waseem (2013), "Using notches to uncover optimization frictions and structural elasticities: Theory and evidence from Pakistan." *The Quarterly Journal of Economics*, 128(2), 669–723.

Kleven, Henrik Jacobsen and Esben Anton Schultz (2014), "Estimating taxable income responses using Danish tax reforms." *American Economic Journal: Economic Policy*, 6(4), 271–301.

Kopczuk, Wojciech (2005), "Tax bases, tax rates and the elasticity of reported income." *Journal of Public Economics*, 89(11-12), 2093–2119.

Le Maire, Daniel and Bertel Schjerning (2013), "Tax bunching, income shifting and self-employment." *Journal of Public Economics*, 107(C), 1–18.

Lee, Lung-Fei, G.S. Maddala, and R.P. Trost (1980), "Asymptotic covariance matrices of two-stage probit and two-stage tobit methods for simultaneous equations models with selectivity." *Econometrica*, 48(2), 491–503.

Mortenson, Jacob A. and R. A. Whitten (2016), "How sensitive are taxpayers to marginal tax rates? Evidence from income bunching in the United States." Http://j.mp/bunchingpaper/.

Piketty, Thomas, Emmanuel Saez, and Stefanie Stantcheva (2014), "Optimal taxation of top labor incomes: A tale of three elasticities." *American Economic Journal: Economic Policy*, 6(1), 230–71.

Saez, Emmanuel (2010), "Do taxpayers bunch at kink points?" *American Economic Journal: Economic Policy*, 2(3), 180–212.

Saez, Emmanuel, Joel Slemrod, and Seth H. Giertz (2012), "The elasticity of taxable income with respect to marginal tax rates: A critical review." *Journal of Economic Literature*, 50(1), 3–50.

Singleton, Perry (2011), "The effect of taxes on taxable earnings: Evidence from the 2001 and related u.s. federal tax acts." *National Tax Journal*, 64(2), 323–52.

Weber, Caroline E. (2014a), "Measuring treatment for tax policy analysis."

Weber, Caroline E. (2014b), "Toward obtaining a consistent estimate of the elasticity of taxable income using difference-in-differences." *Journal of Public Economics*, 117(C), 90–103.

Weber, Michael E. and Victoria Bryant (2005), "The 1999 individual income tax return edited panel." Internal Revenue Service, Washington D.C., http://www.irs.gov/pub/irs-soi/05weber.pdf.

Table 1: Summary Statistics

	Mean	Std. Dev.
Broad Income	81,333	275,801
Taxable Income	55,507	231,810
Ordinary Income MTR	32.0	8.3
Capital Gains MTR	17.0	7.7
Married Dummy	58.6	-
Itemizer Dummy	53.5	-
Business Income Dummy	23.7	-
Number of Children	0.8	1.1
Observations	191,159	

Data are limited to base years used in estimation: 2000-2004. Broad and taxable income are denominated in constant year 2005 dollars. Marginal tax rates are inclusive of state income and federal payroll taxes, where applicable. Δ indicates three-year differences. Sample weights are applied to each item, with the exception of "observations."

Table 2: Ordinary Income Responses: Testing Exogeneity of Instruments

	(1)	(2)	(3)	(4)
$\Delta \ln(1-\tau^o)$	0.074	0.074	0.208	0.431
	(0.077)	(0.077)	(0.269)	(0.451)
Observations	101,357	101,357	101,357	101,357
Clusters	41,616	41,616	41,616	41,616
Number of Lags	0	0, 2, 3	1, 2, 3	2, 3
Diff-in-Sargan		0.41	0.51	0.90
1st-Stage F Stat	2,263	793	74	63

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated coefficients are presented, with tax unit-clustered standard errors in parentheses. These are two-stage least square results, where excluded simulated instruments are constructed using various lags of income. Column 1 uses excluded instruments holding income constant in the base year. Column 2 adds excluded instruments from income lagged two and three periods prior to the base year. Column 3 uses three excluded instruments, constructed using income lagged one, two, and three years. Column 4 uses excluded instruments constructed using income lagged two and three periods. The dependent variable in all four columns is the three-year log change in taxable income. Data are limited to base years 2000-2002. Marginal tax rates are inclusive of federal income, state income, and federal payroll taxes, where applicable. Ten-piece splines in gross income lagged two and three periods prior to the base year are also included as controls. Year and region fixed effects are used, and controls for marital status, age, age-squared, itemizer status, number of children, and the sex of the primary filer are included.

Table 3: Ordinary Income Responses: Own-Tax Elasticities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln(1-\tau^o)$	0.421	0.044	0.498	0.282	0.191	0.330	0.011	0.124
	(0.446)	(0.361)	(0.422)	(0.294)	(0.364)	(0.262)	(0.279)	(0.251)
Observations	102,447	108,401	168,320	102,447	178,213	168,320	108,401	178,213
Clusters	42,483	44,483	46,550	42,483	48,982	46,550	44,483	48,982
Year Differences	3	2	3	3	2	3	2	2
ITT Effect	No	No	No	Yes	No	Yes	Yes	Yes
Additional Data	No	No	Yes	No	Yes	Yes	No	Yes
Diff-in-Sargan	0.94	0.35	0.47	0.90	0.36	0.53	0.34	0.35
1st-Stage F Stat	64	53	70	209	52	254	133	150

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated coefficients are presented, with tax unit-clustered standard errors in parentheses. These are two-stage least square results, where simulated instruments are constructed using various two and three year lags of income. The dependent variable in all four columns is the log change in taxable income. Columns 1, 3, 4, and 6 use three year differences, the other four columns use two year differences. Data are limited to base years 2000-2002 in columns 3, 5, 6, and 8, and 2000-2004 in the other four columns. The definition of treatment is the actual, realized change in marginal tax rates in columns 1, 2, 3, and 5, and is the predicted change holding income constant at base year levels in the other four columns. Marginal tax rates are inclusive of federal income, state income, and federal payroll taxes, where applicable. Ten-piece splines in gross income lagged two and three periods prior to the base year are also included as controls. Year and region fixed effects are used, and controls for marital status, age, age-squared, itemizer status, number of children, and the sex of the primary filer are included.

Table 4: Ordinary Income Responses: Own-Tax and Income Elasticities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln(1-\tau^o)$	-0.385	-0.079	0.140	0.001	-0.068	0.290	0.200	0.117
	(0.747)	(0.545)	(0.708)	(0.464)	(0.578)	(0.410)	(0.394)	(0.353)
$\Delta \ln$(Virtual Income)	-0.030	-0.021	-0.002	-0.027	-0.025	-0.010	-0.025	-0.034
	(0.049)	(0.039)	(0.048)	(0.036)	(0.040)	(0.032)	(0.033)	(0.028)
Observations	64,035	68,644	110,691	66,272	118,385	114,521	70,410	121,544
Clusters	31,511	33,493	36,812	31,914	38,939	37,046	33,725	39,009
Year Differences	3	2	3	3	2	3	2	2
ITT Effect	No	No	No	Yes	No	Yes	Yes	Yes
Additional Data	No	No	Yes	No	Yes	Yes	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated coefficients are presented, with tax unit-clustered standard errors in parentheses. These are two-stage least square results, where simulated instruments are constructed using various two and three year lags of income. The dependent variable in all four columns is the log change in taxable income. Columns 1, 3, 4, and 6 use three year differences, the other four columns use two year differences. Data are limited to base years 2000-2002 in columns 3, 5, 6, and 8, and 2000-2004 in the other four columns. The definition of treatment is the actual, realized change in marginal tax rates in columns 1, 2, 3, and 5, and is the predicted change holding income constant at base year levels in the other four columns. Marginal tax rates are inclusive of federal income, state income, and federal payroll taxes, where applicable. Ten-piece splines in gross income lagged two and three periods prior to the base year are also included as controls. Year and region fixed effects are used, and controls for marital status, age, age-squared, itemizer status, number of children, and the sex of the primary filer are included.

Table 5: Ordinary Income Responses: Own-Tax and Cross-Tax Elasticities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln(1-\tau^o)$	1.445**	0.314	1.326**	0.823**	0.364	0.792**	0.196	0.234
	(0.512)	(0.384)	(0.484)	(0.284)	(0.387)	(0.261)	(0.278)	(0.257)
$\Delta \ln(1-\tau^c)$	-2.392***	-0.561	-1.202**	-1.561**	-0.314	-0.767*	-0.422	-0.244
	(0.665)	(0.428)	(0.463)	(0.476)	(0.380)	(0.366)	(0.336)	(0.320)
Observations	102,233	108,149	168,040	102,255	177,893	168,074	108,172	177,926
Clusters	42,439	44,425	46,511	42,443	48,932	46,514	44,432	48,937
Year Differences	3	2	3	3	2	3	2	2
ITT Effect	No	No	No	Yes	No	Yes	Yes	Yes
Additional Data	No	No	Yes	No	Yes	Yes	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated coefficients are presented, with tax unit-clustered standard errors in parentheses. These are two-stage least square results, where simulated instruments are constructed using various two and three year lags of income. The dependent variable in all four columns is the log change in taxable income. Columns 1, 3, 4, and 6 use three year differences, the other four columns use two year differences. Data are limited to base years 2000-2002 in columns 3, 5, 6, and 8, and 2000-2004 in the other four columns. The definition of treatment is the actual, realized change in marginal tax rates in columns 1, 2, 3, and 5, and is the predicted change holding income constant at base year levels in the other four columns. Marginal tax rates are inclusive of federal income, state income, and federal payroll taxes, where applicable. Ten-piece splines in gross income lagged two and three periods prior to the base year are also included as controls. Year and region fixed effects are used, and controls for marital status, age, age-squared, itemizer status, number of children, and the sex of the primary filer are included.

Table 6: Ordinary Income Responses: Own-Tax, Cross-Tax, and Income Elasticities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln(1-\tau^o)$	0.417	-0.124	0.977	0.565	0.105	0.829*	0.224	0.240
	(0.851)	(0.610)	(0.768)	(0.445)	(0.599)	(0.384)	(0.412)	(0.350)
$\Delta \ln(1-\tau^c)$	-2.233**	-0.476	-1.744***	-1.654**	-0.536	-1.173**	-0.437	-0.468
	(0.715)	(0.468)	(0.521)	(0.503)	(0.404)	(0.399)	(0.369)	(0.337)
Δ ln(Virtual Income)	-0.052	-0.036	-0.014	-0.032	-0.031	-0.013	-0.031	-0.037
	(0.044)	(0.037)	(0.042)	(0.035)	(0.037)	(0.031)	(0.032)	(0.027)
Observations	63,860	68,448	110,474	66,106	118,140	114,318	70,223	121,315
Clusters	31,468	33,445	36,775	31,874	38,902	37,014	33,678	38,971
Year Differences	3	2	3	3	2	3	2	2
ITT Effect	No	No	No	Yes	No	Yes	Yes	Yes
Additional Data	No	No	Yes	No	Yes	Yes	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated coefficients are presented, with tax unit-clustered standard errors in parentheses. These are two-stage least square results, where simulated instruments are constructed using various two and three year lags of income. The dependent variable in all four columns is the log change in taxable income. Columns 1, 3, 4, and 6 use three year differences, the other four columns use two year differences. Data are limited to base years 2000-2002 in columns 3, 5, 6, and 8, and 2000-2004 in the other four columns. The definition of treatment is the actual, realized change in marginal tax rates in columns 1, 2, 3, and 5, and is the predicted change holding income constant at base year levels in the other four columns. Marginal tax rates are inclusive of federal income, state income, and federal payroll taxes, where applicable. Ten-piece splines in gross income lagged two and three periods prior to the base year are also included as controls. Year and region fixed effects are used, and controls for marital status, age, age-squared, itemizer status, number of children, and the sex of the primary filer are included.

Table 7: Ordinary Income Responses: Tax Elasticities for Various Sub-Populations

	$\Delta \ln(1-\tau^o)$	$\Delta \ln(1-\tau^c)$	Δ ln(Virtual Income)	Observations
Over \$50,000	0.552	-0.168	0.002	82,101
	(0.87)	(0.62)	(0.05)	
Over \$100,000	2.808	-1.104	0.201	42,720
	(1.85)	(0.87)	(0.16)	
Capital Gains Income	0.863	-0.577	0.014	51,608
	(1.09)	(0.79)	(0.08)	
Unearned Income	0.475	-0.419	0.005	93,710
	(0.51)	(0.47)	(0.03)	
Pass-through Income	0.956	-0.912	-0.035	45,942
	(1.06)	(0.86)	(0.09)	
Paid Preparer	2.292*	-1.559*	0.079	41,025
	(1.06)	(0.73)	(0.07)	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated coefficients are presented, with tax unit-clustered standard errors in parentheses. These are two-stage least square results, where simulated instruments are constructed using various two and three year lags of income. The dependent variable is the three year log change in taxable income. Base years range from 2000-2004. The definition of treatment is the predicted change holding income constant at base year levels. Marginal tax rates are inclusive of federal income, state income, and federal payroll taxes, where applicable. Ten-piece splines in gross income lagged two and three periods prior to the base year are also included as controls. Year and region fixed effects are used, and controls for marital status, age, age-squared, itemizer status, number of children, and the sex of the primary filer are included.

Table 8: Summary Statistics

	Full Sample		Realizers	
	Mean	Std. Dev.	Mean	Std. Dev.
Net Long-term Gains	1,622	195,172	30,982	703,872
Percent with Positive Net Gains	7.55	-	-	-
ln(Net Long-term Gains)	0.58	2.14	7.66	2.47
ln(Lagged Imputed Permanent Income)	10.69	0.45	10.81	0.43
ln(Imputed Transitory Income)	-0.54	1.27	-0.21	1.37
ln(Imputed Unrealized Gains)	10.63	1.22	11.78	1.38
ln(Lagged Business Losses)	0.11	0.97	0.41	1.87
ln(Lagged Rental Losses)	0.40	1.80	0.94	2.74
Age of Primary	50.6	14.8	59.5	15.6
Children	0.77	1.09	0.54	0.98
Married Dummy	52	-	67	-
Capital Gains Marginal Tax Rate (MTR)	14.8	8.6	18.0	8.3
Ordinary Income MTR	28.4	12.9	33.2	10.6
Carryover Loss Dummy	3.54	-	-	-
Observations	291,506		56,108	

"Realizers" refers to those who realized net positive long-term capital gains. "Gains" or "Capital Gains" refer to long-term capital gains. Data are limited to base years used in estimation: 2000-2006. Dollar amounts are denominated in constant year 2005 dollars. Marginal tax rates are inclusive of state income and federal payroll taxes, where applicable. Sample weights are applied to each item, with the exception of "observations." Imputed wealth values are from the Survey of Consumer Finance and imputed income variables are from the tax data.

Table 9: Transitory Capital Gains Responses to Tax Rates

	(1)	(2)	(3)	(4)
$\widehat{\tau_t^c}$	-0.002*	-0.035***	-0.027***	-0.141***
	(0.001)	(0.004)	(0.003)	(0.029)
$\widehat{\tau_t^o}$	-	-	0.023***	0.091***
	-	-	(0.003)	(0.024)
Inverse Mills Ratio	-	2.420***	-	2.109***
	-	(0.306)	-	(0.302)
ln(Lagged Imputed Permanent Income)	0.198***	1.024***	0.079	0.795***
	(0.047)	(0.185)	(0.049)	(0.195)
ln(Imputed Transitory Income)	-0.002	0.071**	-0.038***	-0.008
	(0.006)	(0.028)	(.007)	(0.033)
ln(Imputed Unrealized Gains)	0.123***	0.656***	0.011***	0.607***
	(0.007)	(0.039)	(0.007)	(0.038)
Carryover Loss Dummy	0.119***	-	0.126***	-
	(0.021)	-	(0.021)	-
Transitory Elasticity Capital Gains	-0.773***		-3.102***	
	(0.087)		(0.629)	
Transitory Elasticity Ordinary Income			3.614***	
			(0.928)	
Observations	291,506	56,108	291,506	56,108

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The dependent variable in columns 1 and 3 is the binary decision to realize capital gains or not. The dependent variable in column 2 and 4 is the level of net positive long-term capital gains realizations. Estimated coefficients are presented, with boot-strapped standard errors in parentheses. All tax variables are "fitted", that is, they are predicted using an OLS regression prior to inclusion in the criterion or level equations. The excluded instrument used for capital gains rates are the first-dollar and maximum rates. The excluded instruments for ordinary income are the predicted rates based on two and three period lagged income. Data are limited to base years used in estimation: 2000-2004. Marginal tax rates are inclusive of state income and federal payroll taxes, where applicable.

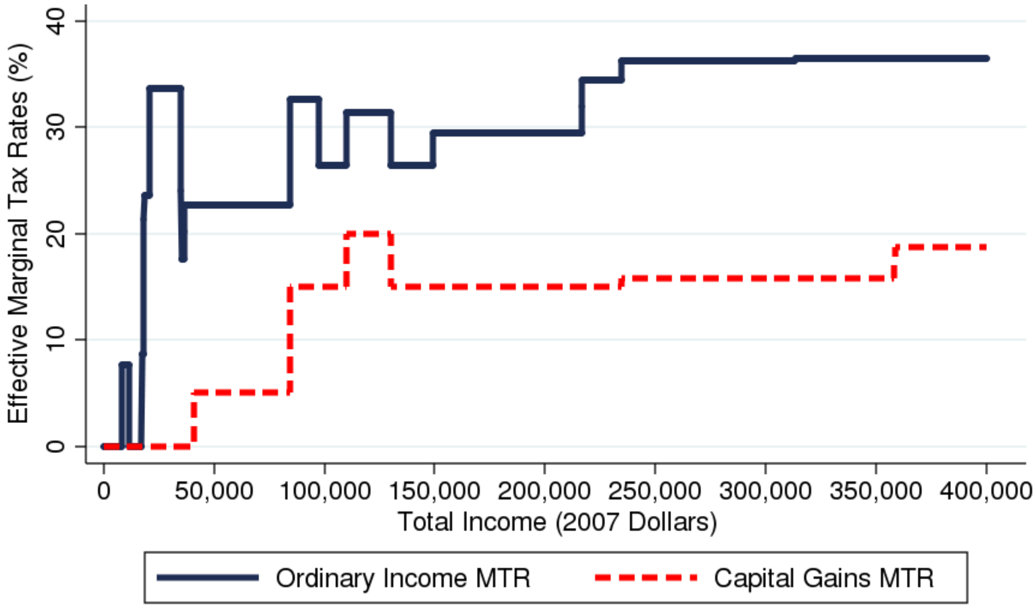
Table 10: Transitory and Persistent Capital Gains Responses to Tax Rates

	(1)	(2)	(3)	(4)
$\widehat{\tau^c_{t+1}}$	-0.029**	-0.094*	-0.010	-0.131
	(0.012)	(0.046)	(0.028)	(0.122)
$\widehat{\tau^c_t}$	0.013	0.014	-0.055	-0.106
	(0.007)	(0.036)	(0.037)	(0.155)
$\widehat{\tau^c_{t-1}}$	0.010***	0.038***	0.035**	0.121**
	(0.002)	(0.006)	(0.011)	(0.05743
Inverse Mills Ratio	-	2.170***	-	2.200***
	-	(0.305)	-	(0.334)
$\widehat{\tau^o_{t+1}}$	-	-	-0.009	0.110
	-	-	(0.027)	(0.116)
$\widehat{\tau^o_t}$	-	-	0.055	0.041
	-	-	(0.035)	(0.150)
$\widehat{\tau^o_{t-1}}$	-	-	-0.022*	-0.078*
	-	-	(0.008)	(0.035)
ln(Imputed Permanent Income)	0.201***	1.095***	0.077*	0.785***
	(0.048)	(0.204)	(0.033)	(0.199)
ln(Imputed Transitory Income)	0.005	0.101**	-0.046***	0.003
	(0.007)	(0.033)	(0.012)	(0.048)
ln(Imputed Unrealized Capital Gains)	0.127***	0.623***	0.102***	0.626***
	(0.007)	(0.040)	(0.009)	(0.035)
Carryover Loss Dummy	0.127***	-	0.135***	-
	(0.021)	-	(0.017)	-
Transitory Elasticity Capital Gains	-	0.316	-	-2.276
	-	(0.774)	-	(3.231)
Persistent Elasticity Capital Gains	-	-0.899***	-	-2.438**
	-	(0.169)	-	(0.847)
Transitory Elasticity Ordinary Income	-	-	-	1.677
	-	-	-	(5.655)
Persistent Elasticity Ordinary Income	-	-	-	2.774*
	-	-	-	(1.233)
Observations	291,506	56,108	291,506	56,108

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

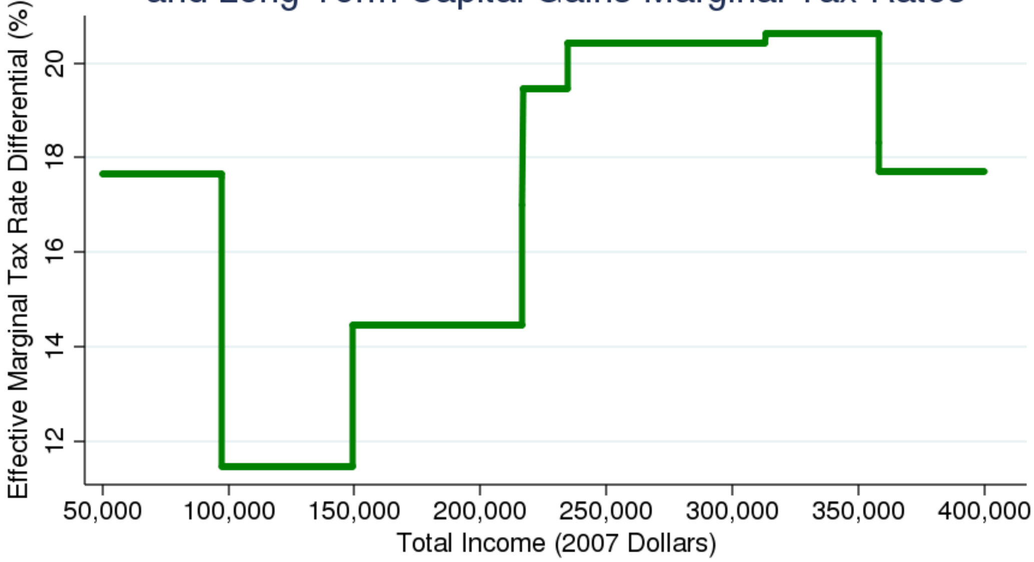
The dependent variable in columns 1 and 3 is the binary decision to realize capital gains or not. The dependent variable in column 2 and 4 is the level of net positive long-term capital gains realizations. Estimated coefficients are presented, with boot-strapped standard errors in parentheses. All tax variables are "fitted", that is, they are predicted using an OLS regression prior to inclusion in the criterion or level equations. The excluded instrument used for capital gains rates are the first-dollar and maximum state and federal tax rates. The excluded instruments for ordinary income are the predicted rates based on two and three period lagged income. Data are limited to base years used in estimation: 2000-2004. Marginal tax rates are inclusive of state income and federal payroll taxes, where applicable.

Figure 1. Effective Marginal Tax Rate Schedules



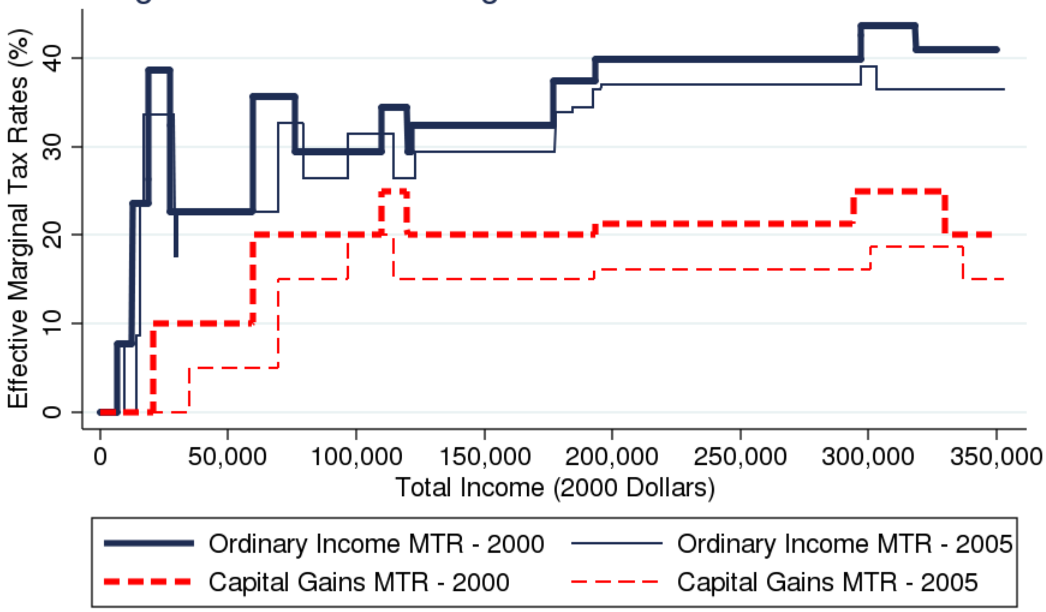
Source: Author's calculations using simulated data. Married, one dependent, Texas, 2007.
The vertical axis is the effective marginal tax rate for a given income type, expressed in percentage points. The horizontal axis is the amount of income of a given type in year 2007 dollars.

Figure 2. Differential Between Ordinary Income and Long-Term Capital Gains Marginal Tax Rates



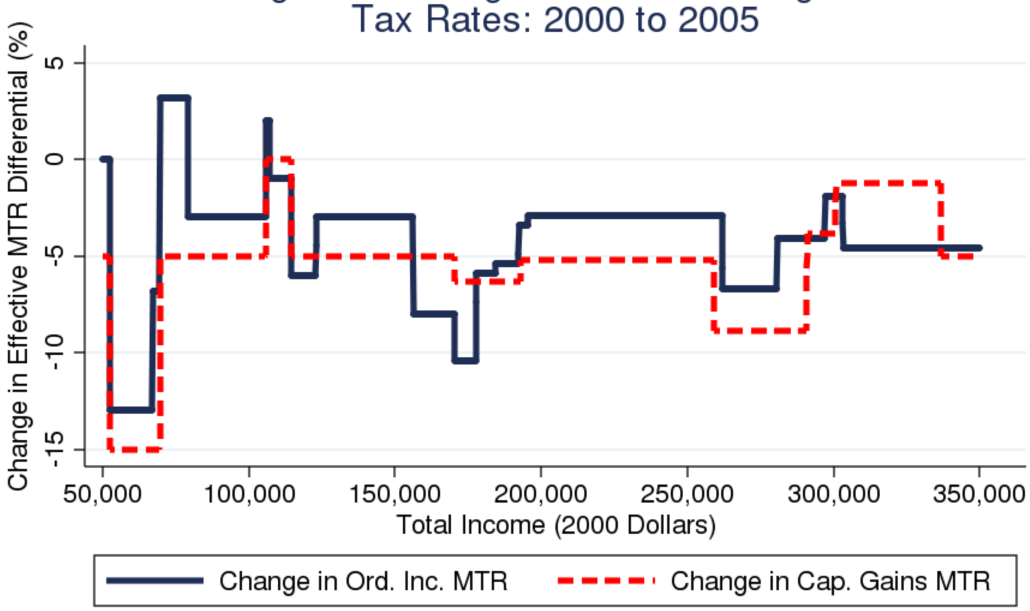
Source: Author's calculations using simulated data. Married, one dependent, Texas, 2007.
The vertical axis is the difference between effective marginal tax rates on ordinary income and long-term capital gains, expressed in percentage points. The horizontal axis is the amount of income of a given type in year 2007 dollars.

Figure 3. Effective Marginal Tax Rates: 2000 and 2005



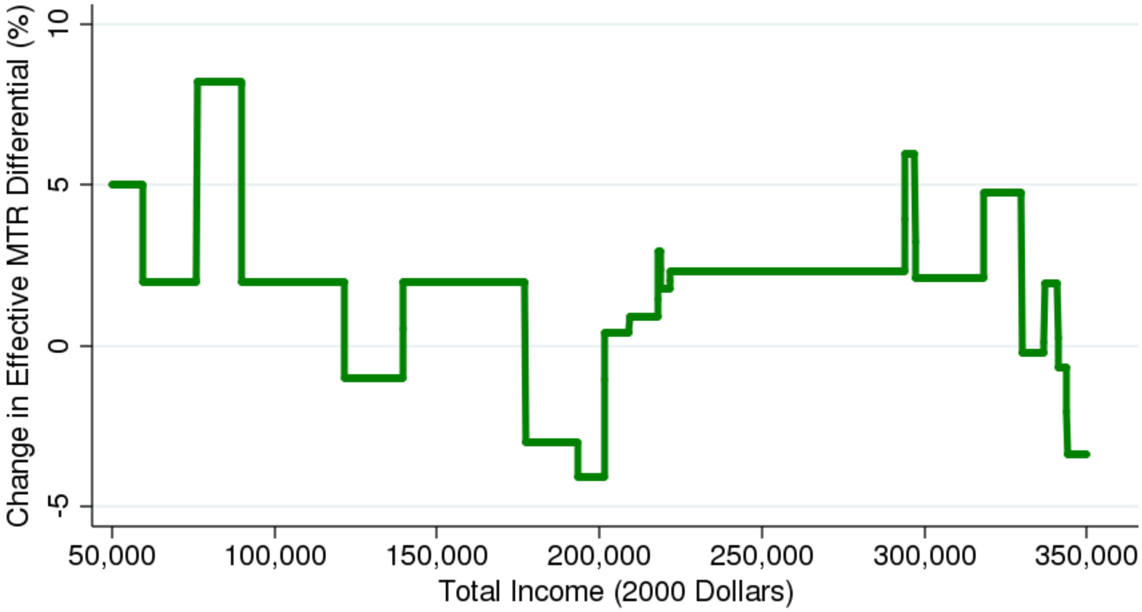
Source: Author's calculations using simulated data. Married, one dependent, Texas, 2000 and 2005. The vertical axis is the effective marginal tax rate for a given income type, expressed in percentage points. The horizontal axis is the amount of income of a given type in year 2000 dollars.

Figure 4. Change in Effective Marginal Tax Rates: 2000 to 2005



Source: Author's calculations using simulated data. Married, one dependent, Texas, 2000 and 2005. The vertical axis is the change in effective marginal tax rate for a given income type, expressed in percentage points. The horizontal axis is the amount of income of a given type in year 2000 dollars.

Figure 5. Change in the Differential Between Ordinary Income and Capital Gains Effective MTRs: 2000 to 2005



Source: Author's calculations using simulated data. Married, one dependent, Texas, 2000 and 2005. The vertical axis is the change in the difference between effective marginal tax rates on long-term capital gains and ordinary income, expressed in percentage points. The horizontal axis the amount of income in year 2000 dollars.